Team Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Team Number: \_\_\_\_\_\_\_

**Meteorology**

**World Climate**

Science Olympiad: Division B

Cobra Invitational - 2015

**Match each term to the correct definition by writing the CAPITAL letter in the space provided.**

\_**P\_** 1. Adaptive Capacity \_**L**\_ 11. Cryosphere

\_**S**\_\_ 2. Biomass \_**J**\_\_ 12. Eccentricity

\_**R**\_ 3. Aerosols \_**K**\_ 13. Enteric Fermentation

\_**G**\_\_ 4. Carbon Footprint \_**D** 14. Forcing Mechanism

\_**O**\_\_ 5. Albedo \_**H**\_ 15. Climate

\_**Q\_** 6. Black Carbon Aerosol **\_C**\_ 16. Heat Island

\_**I**\_ 7. Carbon Cycle \_**F**\_ 17. Climate Feedback

\_**N\_** 8. Biogeochemical Cycle \_**E**\_ 18. Global Warming Potential

\_**B**\_ 9. GHG \_**A**\_ 19. Nitrogen Oxides

**\_T**\_ 10. Evapotranspiration **\_M**\_ 20. Ozone

1. Gases consisting of one molecule of nitrogen and varying numbers of oxygen molecules.
2. Any gas that absorbs infrared radiation in the atmosphere.
3. An urban area characterized by temperatures higher than those of the surrounding
4. A process that alters the energy balance of the climate system.
5. A measure of the total energy that a gas absorbs over a particular period of time.
6. A process that acts to amplify or reduce direct warming or cooling effects.
7. The total amount of greenhouse gases that are emitted into the atmosphere each year by a person.
8. The “average weather” over a long period of time.
9. All parts (reservoirs) and fluxes of carbon.
10. The extent to which the Earth’s orbit around the Sun departs from a perfect circle.
11. Livestock, especially cattle, produce methane as part of their digestion.
12. Ice on Earth.
13. The triatomic form of Oxygen.
14. Movements through the Earth system of key chemical constituents essential to life, such as carbon, nitrogen, oxygen, and phosphorus.
15. The amount of solar radiation reflected from an object or surface.
16. The Ability of a system to adjust to climate change to moderate potential damages.
17. The most strongly light-absorbing component of particulate matter (PM).
18. Small particles or liquid droplets in the atmosphere that can absorb or reflect sunlight depending on their composition.
19. Materials that are biological in origin, including organic material from above and below the ground.
20. The combined process of evaporation from Earth’s surface and transpiration from vegetation.

\_\_\_\_ 21. Which statement best describes why we have air pressure on Earth?

A. We don’t have air pressure, this statement is false.

B. Gas molecules are slow moving

**C. Because we live under a column of air: we are at the bottom of the atmospheric ocean.**

D. Gas molecules are fast moving

\_\_\_\_ 22. As Altitude (km) decreases what happens to Air Pressure and Density?

**A. Air Pressure and Density Increases**

B. Air Pressure and Density Decreases

C. Air Pressure and Density Stay the same

D. Air Pressure increases, and density decreases.

\_\_\_\_ 23. Distinguish between the effects of ozone in the stratosphere and ozone near Earth's surface.

A. Their effects are identical.

B. Ozone in the stratosphere is the only kind that causes smog.

**C. The first protects against UV radiation; the second causes health problems.**

D. Ozone in the stratosphere is the only kind that causes cancer.

\_\_\_\_ 24. Which of the following sources is an example of an anthropogenic source of air pollution?

**A. Landfill gas that contains methane and carbon dioxide**

B. Volcanic activity that produces smoke, ash, and carbon dioxide

C. Windblown dust from areas with little or no vegetation

D. Cows burping

\_\_\_\_ 25. How do mountains contribute to air pollution?

A. They capture ozone from high altitudes and funnel it to lower altitudes.

B. They give off chloroflurocarbons.

C. They provide ideal locations for large factories.

**D. They restrict the movement of air.**

\_\_\_\_ 26. How do chlorofluorocarbons affect the environment?

A. They encourage dense, dirty air to collect in valleys.

B. They cause acid rain.

C. They cause the greenhouse effect.

**D. They may be destroying the protective ozone layer in the stratosphere.**

\_\_\_\_ 27. How does acid rain form?

**A. Sulfur dioxide and nitrogen oxides combine with moisture in air to form acids.**

B. It comes out of air conditioners.

C. It forms when warm air layers keep cooler air underneath from rising.

D. It forms by evaporation from areas where industrial chemicals have been spilled.

\_\_\_\_ 28. What are the two most abundant gases that make up the composition of the Earth’s Atmosphere?

A. Carbon Dioxide and Methane

**B. Nitrogen and Oxygen**

C. Carbon Dioxide and Oxygen

D. Nitrogen and Ozone

29. Name three other gases that make up the Earth’s Atmosphere.

1. \_\_\_Water Vapor\_\_\_\_
2. \_\_\_Argon\_\_\_\_\_\_\_\_
3. \_\_\_Carbon Dioxide\_\_\_\_\_\_\_\_\_\_

\_\_\_\_ 30. All of the following pieces of evidence support climate change except

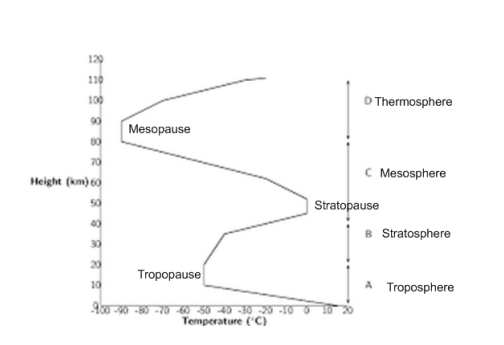
A. Global sea levels rose about 17 centimeters.

**B. Thickness of Arctic sea ice has increased rapidly over the last several decades.**

C. Oceans showing warming of 0.302 degrees Fahrenheit since 1969.

D. The acidity of surface ocean waters has increased by about 30 percent.

**31. Label the layers of the atmosphere, and the areas between the layers in the image below. (7 points)**



32. In which layer do meteoroids burn up? \_\_**Mesosphere**\_\_\_\_\_\_\_

33. In which layer do you find ozone? \_\_**Stratosphere**\_\_\_\_\_\_\_\_\_\_\_

34. In which layer does weather occur? \_\_**Troposphere**\_\_\_\_\_\_\_\_\_\_\_

35. Which is the hottest? \_\_\_\_**Thermosphere**\_\_\_\_\_\_\_\_\_\_\_\_\_\_

36. Which layer is the densest? \_\_\_\_**Troposphere**\_\_\_\_\_\_\_\_\_\_\_\_\_

37. Which layer contains the ionosphere? \_\_\_**Thermosphere**\_\_\_\_\_\_

38. In which layer do we live? \_\_**Troposphere**\_\_\_\_\_\_\_\_\_\_\_\_

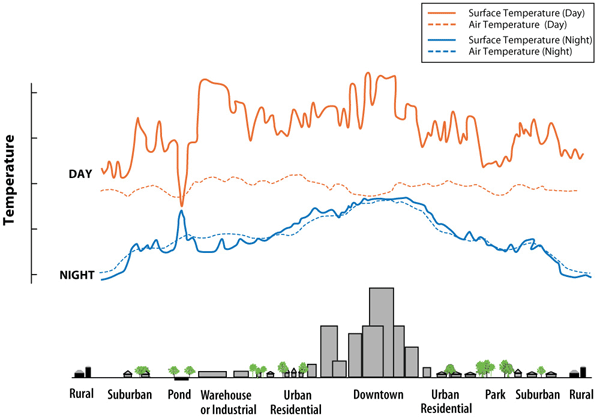
39. In which layer are AM radio signals passed? \_\_**Ionosphere**\_\_\_\_\_\_\_\_\_\_

40. In which layer can you find satellites? \_\_\_\_**Exosphere**\_\_\_\_\_\_\_\_\_

41. The Earth-Atmosphere system as a combined albedo of about \_**30**\_\_%.

\_\_\_\_ 42. All of the following pieces of evidence support climate change except:

1. The acidity of surface ocean waters has increased by about 30%.
2. **Thickness of Arctic sea ice has increased rapidly over the last decades.**
3. Oceans showing warming of 0.302 degrees Fahrenheit since 1969.
4. Global Sea Levels rose about 17 cm.



**Use the image below to above the following questions:**

43. In which areas do you find the highest temperatures? What is the phenomenon called?

**Downtown areas - URBAN HEAT ISLAND AFFECT**

44. Which show the greatest variability air or surface temperatures? Why?

**Surface temperatures - air isn’t a good conductor like land is. Land heats and cools quickly.**

\_\_\_\_ 45. Carbon Dioxide emissions can be reduced by:

1. Increasing energy efficiency
2. Increasing energy conservation
3. burning more natural gas
4. **All of the above.**

46. As Altitude (km) increases what happens to the Temperature of each the layers of the atmosphere? Explain. (4 points)

**Troposphere - cools because moving away from ground that is warm.**

**Stratosphere - temp. increases because ozone absorbs UV radiation**

**Mesosphere - temp. decrease - no ozone**

**Thermosphere - temp. increase - few molecules, but high energy/temp. - outermost.**

47. An ideal white body has an albedo of \_**100**\_ % and an ideal black body has an albedo of **0** %.

\_\_\_\_ 48. The phenomenon of enhanced warming, due to increased solar absorption by vegetation and water that was previously covered by snow and ice, is referred to as:

1. Global Warming
2. **Polar Amplification**
3. Climate Change
4. Climate Forcing

\_\_\_\_ 49. Which of the following can be attributed to El Niño?

A. increases in nutrient upwellings off the coast of Peru

B. increases in seabird populations

**C. changes in global atmospheric circulation**

D. global warming of the Earth

\_\_\_\_ 50. A warmer ocean stores less carbon dioxide (CO2) than a cooler one.

**A. True**

B. False

51. Oceans have \_**increased**\_ in acidity, as emissions of carbon dioxide have continued to increase

52. The concentration of \_\_**methane**\_\_ in the atmosphere has more than doubled in the past 200 years, and is thought to contribute approximately 12 to 20% of the anthropogenic greenhouse effect.

\_\_\_\_ 53. In models of global warming, the most important factor contributing to an increase in sea level is

A. Increased Precipitation

B. Decreased Evaporation

**C. thermal expansion of the oceans**

D. Subsurface ocean cooling

E. Growth of polar ice caps.

54. Explosive volcanic eruptions result in producing sulfate aerosol clouds in the stratosphere. These clouds are transported around the world by winds. When this occurs the surface temperature \_\_**Increases**\_ after each large eruption, in proportion to the thickness of the stratospheric cloud.

\_\_\_\_\_ 55. The Greenhouse Effect:

**A. Traps some heat and reflects it back to the Earth, but also vents the extra heat out into space.**

B. Is the effect that greenhouses have on heating the Earth.

C. Makes the Earth cooler.

56. What important ocean surface current keeps Britain relatively warm (temperate climate) all year round?

\_\_**Gulf Stream**\_\_\_\_\_\_\_

57. What force causes ocean surface currents? \_\_\_**Winds**\_\_\_\_\_\_\_\_

58. Large circling patterns of surface currents are called \_\_**Gyres**\_\_\_\_\_\_\_\_,

59. Is the California Current warm or cold? Why? (2 points)

**Cold, upwelling from the Arctic.**

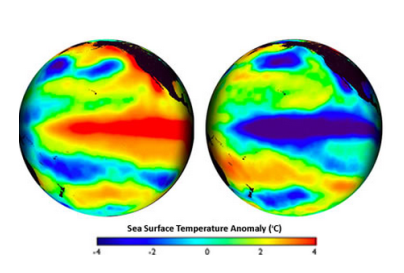
60. What force drives the direction of the Gyres (clockwise/counterclockwise)?

**Coriolis Effect**

\_\_\_\_ 61. The driving force of the thermohaline conveyor is:

1. Winds
2. Coriolis Effect
3. **Salty, cold Arctic Water**
4. Convection

62. Which graph is showing el Niño conditions? How do you know? **A, Warm surface currents moving to the East towards S. America**



**A** **B**

\_\_\_\_ 63. During an El Niño, large amounts of fish often die. Why?

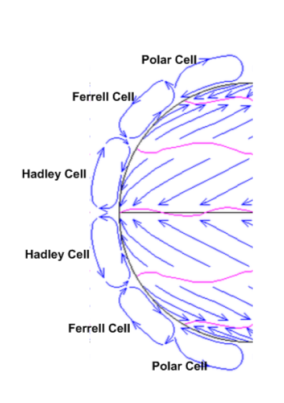
A. Cold, nutrient rich water does not make it to the surface during an El Niño.

B. Too much nutrients in the water overwhelm the fish population

C. Powerful trade winds kill the fish

D. Warm, nutrient waters sink along the coast starving the fish.

64. Label the Air Circulation Cells on the diagram below. (3 points)



\_\_\_\_ 65. Which of the following is not considered a semi-permanent high or low pressure area?

A. Bermuda high

B. Aleutian low

**C. Siberian high**

D. Pacific high

E. Icelandic high

\_\_\_\_ 66. In terms of the three-cell model of the general circulation, areas of surface low pressure should be found

at:

A. the equator and the poles.

B. the equator and 30° latitude.

**C. the equator and 60° latitude.**

D. 30° latitude and 60° latitude.

\_\_\_\_ 67. In the Northern Hemisphere, ocean currents in the Atlantic and the Pacific move in a generally circular pattern. The direction of this motion is \_\_\_\_ in the Atlantic and \_\_\_\_ in the Pacific.

A. clockwise; counterclockwise

B. counterclockwise; counterclockwise

**C. clockwise; clockwise**

D. counterclockwise; clockwise

\_\_\_\_ 68. A condition where the central and eastern tropical Pacific Ocean turns cooler than normal is called:

A. El Niño.

**B. La Niña.**

C. the Southern Oscillation.

D. the Ekman Spiral.

69. What 2 physical interactions is the Thornthwaite Climatic Classification System built around?

**Vegetation Characteristics**  **determined by Local Moisture & Temperature**

70. What 2 physical interactions is the Koppen System of Climate Classification built around?

**Precipitation & Temperature Data**

What do the following abbreviations stand for in The Thornthwaite Climate Classification System?

77. PE - \_\_**Potential Evapotranspiration**

78. T/ET - \_\_\_**Thermal Efficiency Index**\_

79. T - \_\_\_**Temperature**\_\_\_\_\_\_\_\_

80. ET - \_\_\_**Evapotranspiration**\_\_\_\_\_\_\_\_

81. DI - \_\_\_**Dryness Index**\_\_\_\_\_\_\_\_

82. HI - \_\_\_\_**Humidity Index**\_\_\_\_\_\_\_\_\_\_

\_\_\_\_ 82. The Koppen system of climate classification is based on \_\_\_\_\_\_ data.

1. solar radiation
2. **temperature and precipitation**
3. evapotranspiration
4. sensible temperature indices

\_\_\_\_ 83. The desire to simplify, organize, and generalize the vast array of climatic data into a comprehensible system that helps us understand the distribution of climates over Earth leads to \_\_\_\_\_\_.

1. **classification**
2. averaging
3. weather forecasting
4. compromise

\_\_\_\_ 84. The climatic type for the desert areas is \_\_\_\_\_\_.

1. Am
2. **BW**
3. Aw
4. Dfa

\_\_\_\_ 85. Another designation for mediterranean climate is \_\_\_\_\_\_.

1. **dry subtropical**
2. midlatitude steppe
3. upland savanna
4. boreal forest

\_\_\_\_ 86. The main reason for the occurrence of subtropical deserts around the world is:

1. **locations of the subtropical high pressure systems**
2. the westerly winds
3. the intertropical convergence
4. easterly winds

\_\_\_\_ 86. Which climate type is known for clear skies in the summertime?

1. Af
2. Cfa
3. Dfa
4. **Csa**

\_\_\_\_ 89. The Koppen system of climatic classification \_\_\_\_\_\_\_\_\_\_.

1. was the first numerical system
2. is widely used today
3. uses vegetation boundaries as climatic boundaries
4. **all of the above**

\_\_\_\_ 90. In the tropical rainforest, precipitation is mainly \_\_\_\_\_\_.

A) frontal B) unreliable  **C) convective**  D) orographic

\_\_\_\_ 91. The urban heat island is:

**A. warmer air temperatures in urban areas compared to surrounding rural areas**

B. a concentration of energy use in an urban area

C. locating factories in a single location downwind from cities

D. use of conservation techniques to reduce energy use in cities

\_\_\_\_ 92. The Milankovitch Theory proposes that climatic changes are due to:

**A. variations in the earth's orbit as it travels through space**

B. volcanic eruptions

C. changing levels of CO2 in the earth's atmosphere

D. particles suspended in the earth's atmosphere

\_\_\_\_ 93. The climate of the last 1000 years can be characterized as:

**A. a Medieval Warm Period, a cold Little Ice Age, and a warming trend since the late 19th**

B. a mid-Holocene maximum, a Medieval Warm Period, and a cold Little Ice Age

C. a predominantly warm period

D. all of the above.

\_\_\_\_\_95. Which of the following is in the correct sequence from long to short term effects on climate?

A. plate tectonics – Earth’s orbital parameters – ENSO – seasonal changes in latitudinal distribution of insolation

B. mountain building – the Southern Oscillation – precession - seasonal changes in latitudinal distribution of insolation

C. eccentricity – obliquity – precession – the ocean conveyor belt – ENSO

**D. both A and C are correct**

\_\_\_\_ 96. Which of the following is NOT true about the Milankovitch Cycles?

A. They explain glacial and interglacial intervals during the current Icehouse climate period.

B. One part of the cycle is the change in the tilt of the Earth about every 40,000 years.

C. One part of the cycle is the change in the shape of the Earth’s orbit over time scales of 100,000 years.

**D. One part of the cycle is the wobbling of the spin axis about every 10,000 years.**

\_\_\_\_ 99. If the earth were in a cooling trend, which process below would most likely act as a positive feedback mechanism?

**A. increasing the snow cover around the earth**

B. increasing the water vapor content of the air

C. decreasing the amount of cloud cover around the globe

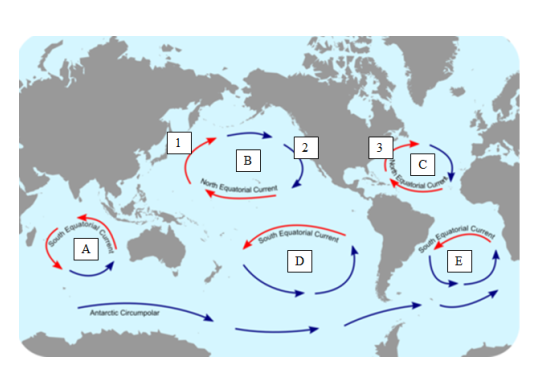
\_\_\_\_ 100. If the earth were in a warming trend, which of the processes below would most likely act as a negative feedback mechanism?

A. increasing the water vapor content of the air

**B. increasing the snow cover around the earth**

C. decreasing the amount of cloud cover around the globe

D. increasing the carbon dioxide content of the air



Gyres

A. \_\_\_**Indian Ocean Gyre**\_

B. \_\_**North Pacific Gyre**\_\_\_\_\_\_\_

C. \_**North Atlantic Gyre**\_\_\_\_\_\_\_\_

D. \_\_**South Pacific Gyre**\_\_\_\_\_\_\_\_\_\_

E. \_\_**South Atlantic Grye**\_\_\_\_\_\_\_\_\_

Currents

1. \_\_**Kuroshio (N. Pacific) Current**\_\_\_\_\_

2. \_\_**California Current**\_\_\_\_\_

3. \_\_\_**Gulf Stream Current**\_\_\_\_\_\_\_\_\_\_